CLAIMS

1. A method of restoring the transparency of a quartz material having implanted gallium that reduces the transmission of the quartz material, comprising:

directing a gas towards a gallium implanted portion of the quartz material; and

directing an electron beam towards the gallium implanted portion of the quartz material, the electron dose of the electron beam being such that the thickness of the quartz material is substantially unchanged, and the transmission of the quartz material is substantially increased.

2. The method of claim 1 in which directing a gas towards the portion of the quartz material includes directing a gas comprising a halogen compound.

3. The method of claim 2 in which directing a gas towards the portion of the quartz material includes directing a gas comprising xenon difluoride.

4. The method of claim 1 in which directing an electron beam towards a portion of the quartz material includes directing an electron beam towards a portion of the quartz material such that the transmission is increased to greater than 80% of the transmission of the quartz material without implanted gallium.

5. The method of claim 1 in which directing an electron beam towards a portion of the quartz material includes directing an electron beam toward a portion of the quartz material such that the transmission is increased to greater than 90% of the transmission of the quartz material without implanted gallium.

6. The method of claim 1 in which directing an electron beam toward a portion of the quartz material includes directing an electron beam toward a portion of the quartz material such that the thickness of the quartz material changes by less than 2 nm.

7. The method of claim 1 in which directing an electron beam toward a portion of the quartz material includes directing an electron beam toward a portion of the quartz material such that the thickness of the quartz material changes by less than 5 nm.

8. The method of claim 1 in which directing an electron beam toward a portion of the quartz material includes directing an electron beam toward a portion of the quartz material such that the thickness of the quartz material changes by less than 10 nm.

9. The method of claim 8 in which includes directing an electron beam toward a portion of the quartz material such that the transmission is increased to greater than 90% of the transmission of the quartz material without implanted gallium.

10. The method of claim 1 in which directing an electron beam towards a portion of the quartz material includes providing an electron dose of less than 2.0 $nC/\mu m^2$.

11. The method of claim 10 in which directing an electron beam toward a portion of the quartz material includes providing an electron dose of between about 0.1 $nC/\mu m^2$ and about 1.0 $nC/\mu m^2$.

12. The method of claim 11 in which directing an electron beam toward a portion of the quartz material includes providing an electron dose of between about 0.4 $nC/\mu m^2$ and about 0.8 $nC/\mu m^2$.

13. A method of restoring the transparency of a transparent substrate having an implanted material that reduces the transmission of the substrate, comprising:

providing a gas at the surface of a substrate; and

directing an electron beam toward the substrate, the electron beam, the gas and the substrate interacting to increase the transparency to the substrate.

14. The method of claim 13 in which providing a gas at the surface of the substrate includes providing a gas including a halogen at surface of the substrate.

15. The method of claim 14 in which providing a gas including a halogen at surface of the substrate includes providing a gas including xenon difluoride.

16. The method of claim 13 in which directing an electron beam toward the substrate includes directing a beam toward a quartz substrate.

17. The method of claim 13 in which directing an electron beam toward the substrate includes directing a beam toward a lithography mask.

18. The method of claim 13 in which directing an electron beam toward the substrate includes providing an electron dose of less than 1.0 $nC/\mu m^2$.

19. The method of claim 18 in which directing an electron beam toward the substrate includes providing an electron dose of less then 0.5 $nC/\mu m^2$.

20. The method of claim 13 in which directing an electron beam toward the substrate includes restoring the transparency of the substrate to greater than 90% of the transparency without the implanted material.

21. The method of claim 20 in which directing an electron beam toward the substrate includes etching the substrate by less than 5 nm.

22. The method of claim 13 in which directing an electron beam toward the substrate includes etching the substrate by less than 5 nm.